Frequently Asked Questions (FAQs) on the Adult Lead Model

Who is the receptor population for the Adult model?

The receptor is the fetus of a woman exposed to lead in a non-residential scenario. Based on the available scientific information, a fetus is believed to be more sensitive to the adverse affects of lead than an adult. Thus, preliminary remediation goals (PRGs) that are protective of a fetus should also afford protection for adults. All the equations and the geometric standard deviation (GSD) of the model are used to calculate PRGs based on the probability of exceeding a blood lead (PbB) of 10 µg/dL for a fetus.

Does the model calculate a value for a commercial worker or for an industrial worker?

The guidance does not distinguish between commercial and industrial workers; rather, it is applicable for non-residential exposure scenarios. A soil ingestion rate of 50 mg/day is recommended as a plausible central tendency value for non-contact intensive activities. A commercial worker may work primarily indoors, so that exposure to soil occurs primarily from indoor dust. An industrial worker may be defined as an individual who works indoors and outdoors. If an individual is performing a contact intensive activity with soil, then a soil ingestion rate greater than 50 mg/day may be reasonable. Historical lead industries would have to be evaluated individually to determine the indoor and outdoor activities that may result in greater exposure to soil and the corresponding soil ingestion rate.

What is a reasonable screening value for soil lead at commercial/industrial sites?

A screening goal is different from a cleanup goal. A screening goal is intended to incorporate an appropriate level of conservatism to provide for health protection in the absence of data on the specific conditions of exposure at a site. A cleanup goal can be derived using exposure assumptions based on site-specific data rather than conservative default values. A reasonable screening level for soil lead at commercial/industrial (*i.e.*, non-residential) sites is 750 ppm (Figure 2 of the Guidance). In this figure, results using alternate choices for certain key model parameters are presented to show the dependence of calculated PRGs on these choices.

What is an appropriate soil ingestion rate for a construction scenario (*i.e.*, soil contact intensive scenario)?

There is uncertainty in soil ingestion rates (IR_s) for adults due to a lack of reliable empirical data. For construction workers and other soil contact intensive occupations, OSWER guidance recommends an upper bound value for IR_s of 480 mg/day based on conservative assumptions regarding soil adherence to hands. Given more recent soil adherence data and the fact that central tendency values should be used as inputs to the model, a plausible range for IR_s is 50 to 200 mg/day. An appropriate default value for contact intensive scenarios is 100 mg/day.

What is a reasonable baseline blood lead level (PbB_0) to use for a future exposure scenario?

Although the best estimates for PbB_0 are based on site-specific data, such information may not be available for a future exposure scenario. Table A-2 of the guidance presents 95% confidence intervals for the geometric mean PbB_0 for different ethnic and racial categories. A plausible range for PbB_0 is 1.7 to 2.2 µg/dL. If no demographic information is available to indicate that the population is on the high or low end, an appropriate value for PbB_0 is 2.0 µg/dL. Site-specific values outside of the plausible range should be reviewed for applicability.

What is a homogenous population? A heterogenous population? That is, what GSD is appropriate for my site?

The Geometric Standard Deviation (GSD) blood lead (PbB) for a population depends on inter-individual variability in exposure and biokinetics. Factors that may contribute to variability include socioeconomic and ethnic characteristics, activity patterns, degree of urbanization, geographic location, and sources of lead. A homogeneous population (*i.e.*, expected to have a low GSD) may have similar characteristics, and live within a small geographic area with a dominant source of lead (*e.g.*, Mormons living in a mining town). By contrast, individuals with diverse backgrounds, who are exposed to multiple sources of lead within an urban community, may be considered a heterogeneous population. A plausible range for GSD is 1.8 to 2.1.

In the absence of demographic and environmental information that would indicate that the population is either homogeneous or heterogenous, an appropriate value for GSD is 2.0. Site-specific values outside of this range should be reviewed for applicability.

Should I assume that the indoor dust lead level is the same as the outdoor soil (dust) lead concentration when I run the model?

An appropriate assumption is that the concentration of lead in outdoor soil and indoor soil-derived dust is the same. This is not the same as assuming the concentration of lead in outdoor soil and all sources of dust (*i.e.,* aggregate dust) are equal. The concentration of lead in aggregate dust may reflect a combination of outdoor soil, indoor lead sources (*e.g.,* paint), and non-lead sources (*e.g.,* organic material). Since the default assumption for the model is that soil ingestion represents outdoor soil and indoor soil-derived dust only (without contributions from other sources of lead), no distinction is needed between soil and dust concentrations.

What is the appropriate exposure frequency for a typical commercial/industrial worker...250 days, 219 days, or some other derived value for intermittent exposure?

An appropriate default value for exposure frequency (EF) is 219 days/year. This value is a central tendency estimate for non-residential exposure scenarios (i.e., both commercial and industrial), and corresponds to the average time spent at work by both full-time and part-time workers engaged in non-contact intensive activities. If workers are engaged in full-time contact intensive activities, then an EF greater than 219 days/year may be appropriate.

The model is designed to estimate blood lead concentrations (PbB) for workers who have a sustained period of contact with exposure media. The default assumption for the averaging time (AT) is 1 year (365 days), which is sufficient time for PbB to approach quasi-steady state (see Guidance). If exposures are expected to occur over a shorter time interval, then EF should not be prorated over the entire year. For example, average daily lead intake from soil for a construction worker who works 120 days during a 180-day period would be assessed using AT of 180 days rather than 365 days to avoid "diluting" the exposures over the entire year.

What is the shortest period of time for which I can apply the model?

The exposure duration (ED) should be sufficiently long to allow blood lead concentrations (PbB) to approach quasi-steady state. As discussed in the guidance, the shortest period of time appropriate for ED is 3 months (90 days).

Is soil lead (from Equation 1) the site soil concentration that the adult is exposed to (like the exposure point concentration)?

Yes, the soil lead in Equation 1 refers to the exposure point concentration. The definition is "the portion of soil to which adults are most likely exposed" (page 4, assumption 3 in the Guidance).

The model accounts for exposures that occur on a regular basis. Under both current and future exposure scenarios, an arithmetic mean concentration should be estimated from sampling data within the exposure area that a worker would be expected to have access to on a regular basis. Half an acre is reasonable default assumption. Site-specific information may suggest workers are exposed to a greater area (*e.g.,* lineman) or a smaller area (*e.g.,* small commercial facility site).

Substituting an adult benchmark of 10 µg/dL for hypertension in adults into Equation 4 for the blood lead adult central goal yielded a preliminary remediation goal (PRG) that is approximately 3 times higher than if Equations 1–4 (for construction worker scenario) was used.

The 10 µg/dL benchmark is intended to represent the 95th percentile fetal blood lead concentration ($PbB_{fetal,0.95,goal}$), not the blood lead adult central goal ($PbB_{adult,central,goal}$). Using Equation 3, a blood lead adult central goal of <u>10 µg/dL</u> corresponds with a 95th percentile fetal blood lead concentration of approximately 24 µg/dL (assuming GSD of 1.8), whereas an adult central goal of <u>4.2 µg/dL</u> is needed to achieve an appropriate 95th percentile fetal blood lead of 10 µg/dL. Assuming a baseline blood lead (PbB_0) of 1.7 µg/dL, use of an adult central goal of 4.2 µg/dL in Equation 4 yields a PRG of approximately 1750 ppm, while use of an adult central goal of 10 µg/dL yields a PRG of approximately 5750 ppm, a 3-fold difference. The PRG will increase as the acceptable PbB concentrations increase.

Can the Adult Lead model be used to evaluate dietary lead exposures, specifically, fish ingestion?

Yes, if good information on exposures and bioavailability for the exposure pathways is available/ known. For dietary exposures, consideration should be given to the effect of mealtime on lead bioavailability. In the case of fish ingestion, since fish are likely to be eaten at mealtime, the bioavailability of lead in the fish would probably be in the 3-10 % range, based on empirical data on lead absorption with meals in adults (see Guidance).

Equation 1, used to calculate the central estimate of blood lead (PbB) in adults in the Guidance, would be modified as follows:

$$PbB_{adult,central} = PbB_{adult,0} + \frac{BKSF\,(PbS \cdot IR_S \cdot AF_S + PbF \cdot IR_F \cdot AF_F) \cdot EF}{AT}$$

Equation 4, used to calculate PRG in the guidance, would be modified as follows:

$$PbS = \frac{(PbB_{adult,central,goal} - PbB_{adult,0}) \cdot AT}{(BKSF \cdot IR_S \cdot AF_S \cdot EF)} - \frac{PbF \cdot IR_F \cdot AF_F}{IR_S \cdot AF_S}$$

where:

PbF	=	Fish lead concentration ($\mu g/g$) appropriate average concentration
IR_F	=	Intake rate of fish (g/day)
AF_S	=	Absolute gastrointestinal absorption fraction for ingested lead in fish (dimensionless).

While these equations illustrate a methodology for adding a dietary exposure pathway to the model, to some extent, dietary exposures are already accounted for by the baseline blood lead concentration (PbB_0) [see Guidance]. Site specific assumptions regarding dietary exposures and PbB_0 should be reviewed for applicability prior to using the above equations.

What preliminary remediation goals (PRGs) would be obtained if only the defaults values were used?

If defaults were used, PRGs in the range of 750–1750 would be obtained depending on the GSD and baseline blood lead used (see Figure 2 in Guidance).

Is the entire population represented by non-Hispanic white, non-Hispanic black, and Mexican American (reference: Adult Guidance—Appendix A, Table A-1)? How would local census data be used with the information in Table A-1?

The entire population is not represented by these three groups, although these are the three largest race/ethnicity subgroups in the U.S. population (Brody *et al.,* 1994). Assumptions will have to be made in risk assessments for populations for which there are limited data to extrapolate from NHANES. Table A-1 offers some guidelines and a justification to consider differences in race/ethnicity populations and perhaps, the use of a more conservative value when specific population data are not available. All assumptions used will have to be documented in the risk assessment.

Can the model be used to estimate adolescent trespassing? How would the model be applied when the receptor is an adolescent? What baseline blood lead level is appropriate? What about other input parameter values?

The model can be applied to trespasser scenarios and adolescent receptors, provided that the following (appropriate model) conditions are met: (1) exposure frequency (EF); (2) exposure duration (ED); (3) baseline blood lead (PbB_0); (4) absorption fraction (AF). At this time, while empirical data on biokinetic slope factors (BKSF) appear to be similar for young children and adults, there is uncertainty in applying a similar estimate for adolescence. In addition, selecting an appropriate baseline blood lead (PbB_0) is likely to be difficult. Brody *et al.* (1994) have reported low PbB_0 for children between the ages of 12 and 18 years of age (which results in PRGs ranging from 1800–2000 ppm). The low PbB_0 may be due to a growth spurt in which there is a shift of lead from blood to bone. National databases (*e.g.,* NHANES II) can provide quality information on PbB_0. The PRGs calculated using low PbB_0 data can be used as an upper bound and PRGs using adult PbB_0 as a lower bound. Use of the appropriate model defaults or site-specific inputs is important because it can impact the usability of the model for such novel scenarios.

Is 10 μg/dL (in the construction scenario) a level that should never be exceeded?

The 10 μg/dL is a level of concern (LOC) to protect sensitive populations (neonates, infants, and children). The protection of sensitive populations is assumed to also provide protection for adults. The EPA's stated goal for lead is that individuals exposed at a risk based cleanup level would have no more than a 5% probability of exceeding that LOC.

Can the model be used to determine dermal exposure to lead at a site?

Although percutaneous absorption is generally not a significant route of exposure for inorganic lead, technically, the model can evaluate dermal exposure by incorporating the lead uptake from this pathway into the appropriate equation (see Equation A-3 in the Guidance). However, at this time, quantifying uptake from dermal exposure to soil-borne lead is not recommended due to the uncertainty in assigning a dermal absorption fraction that would apply to the numerous inorganic forms of lead that are typically found in environmental settings.